A -a assoc runtime flag, Honeyd, 115 -A flag, NMap, 17 Abstract Syntax Notation One (ASN.1) vulnerability, 237 Abuse reports, 164 ACK flag, TCP, 6 Acknowledgement, TCP, 5 action, template, 118 Active client-side honeypots defined, 238–239 high-interaction. See High-interaction client honeypots overview of, 239–241 Active Sink, iSink, 226–228 AdAware antispyware tool, 265–266 ADDCOMMAND, Kebes, 288 Address Resolution Protocols. See ARPs (Address Resolution Protocols) Address space, detecting UML, 300–301 ADS (Alternate Data Stream), 363 Advertisement addons, with botnets, 385 Agobot, 293 searching for e-mail address on infected host, 367 stealing CD-keys, 367 and variants of, 362–363 AIMBuddyList honeypot, 88 AIRCBot, 365–366 Ajax (Asynchronous JavaScript and XML), 333 Alerts, Argos, 62 Alias interfaces, configuring nepenthes, 184 Alternate Data Stream (ADS), 363	CWSandbox, 405–413 Honeytrap, 197 .ANI files vulnerability, 232–233 AntiVir Workstation, 407 Antivirus engines, 244–245, 407, 411 API hooking with CWSandbox, 393 integrity checks using, 256 overview of, 396–400 wih CWSandbox, 402, 404 Application Layer, Internet protocol suite, 2 Architecture Collapsar, 211–213 CWSandbox, 402–404 HoneyC, 246–248, 260–262 HoneyClient, 258–259 Honeyd, 110 nepenthes, 167–170 Potemkin, 216–219 RolePlayer, 222 VMware, 22–23, 290 Argos, 52–62 control socket, 61–62 nepenthes integration with, 187 network setup for, 57–61 overview of, 52–54 sytem setup with QEMU, 54–57 ARPs (Address Resolution Protocols) Honeyd and, 106–107, 113 LaBrea detecting available IP addresses with, 74 overview of, 4 ASCII code, analysis of, 395 ASN.1 (Abstract Syntax Notation One) vulnerability, 237
marysis report	(11jax), )))

Automation, CWSandbox dynamic analysis, 392–393 Autonomous spreading malware nepenthes collecting, 176 overview of, 391–392 AV signatures, 389 -b (-log-bandwidth), LaBrea installation, 77	Bobax, 365 Bofra worm, 235–236 Border Gateway Protocol (BGP), Potemkin, 216–217 Botnets, 359–390 Agobot and variants, 362–363 aIRCBot, 365–366 Bobax, 365 control structure of, 369–372
В	Dataspy Network X, 365
Backdoor	DDoS attacks caused by, 373
bindtty, in Red Hat compromise, 343	defending against, 387–390
Data ChaOS Connect Back Backdoor,	defined, 359
334, 340	kaiten, 366
I/O, detecting virtual machines, 293–294	mIRC-based bots, 364
Multipot emulating, 204	overview of, 360–362
shell.php, in Windows 2000	possible usages of, 384–387
compromise, 347	Q8Bot, 366
Backus-Naur form (BNF), 313	SDBot and variants, 363–364
BADTHINGS_IN-limit log, Tiny	social life of owners, 384
Honeypot, 86	spyware in the form of bots, 366–369
BADTHINGS_IN log, Tiny Honeypot, 86	Storm Worm, 365
Bait and Switch networks, 125	Toxbot, 365
Behavior analysis, 395–396	tracking, 373–376
Best effort protocol, IPv4 as, 3	Xot and XT Bot, 365
BGP (Border Gateway Protocol),	Zotob/Mytob, 364
Potemkin, 216–217	Botnets, case studies
BHOs (Browser Help Objects),	Mocbot and MOS06-040, 381-384
240, 385	other observations, 384–387
Billy Goat, 205–206	overview of, 376–380
Binary packers, 395	Bots, 360–362. See also Botnets
Bind command, 123–124	Botspy, 376
Bindtty, 343	Bridged networking, 27
Bitdefender, 407	Bridging modules, 186–187
Blackholes, 206	Broadcast, 3
Blacklists, 242	Browser Help Objects (BHOs), 240, 385
Blast-o-Mat, 308–321	Brute-force attacks, 341–342
as alternative to classic IDS system, 309	Byte alignment algorithm, RolePlayer, 223
Haxdoor trojan and, 316–320	
lessons learned, 320–321	
mitigating infected system, 312–316	C
modules, 310–311	C&C (Command and Control) server
overview of, 308	Agobot and variants using, 362–363
Blast-PortScan module, Blast-o-Mat, 310	in botnet case studies, 376–380
Blast-Sniffer module, Blast-o-Mat, 310	in CWSandbox analysis reports,
Blast-SpamDet module, Blast-o-Mat, 310	410–411, 412
Blaster worm, 220–221	defending against bots, 388–389
Bleeding Edge Threats, 242	defined, 360
BNF (Backus-Naur form), 116	setting up botnets with, 369–371

Call tree, CWSandbox analysis report, 406	Command and Control server. See C&C
Capture logs, Tiny Honeypot, 83–84	(Command and Control) server
CD-keys, bots stealing, 367	Command-line flags. See Runtime flags,
CD-ROMs	command-line
Honeywall installation, 67-69	Command line flags, nepenthes, 181–183
installing OS on virtual honeypots,	Command redirection, nepenthes,
33–34, 36–37	169–170, 174
Chats, 243	Commands
chroot jails, 98-100	Argos control socket, 62
ClamAV	botnet setup, 371–372
CWSandbox analysis report, 407, 411	Kebes, 288
detecting malicious web pages, 244	Commercial off-the-shelf (COTS)
SpyBye using, 268	computer, 20
cleanup_module(), disabling Sebek with,	Congestion control, TCP, 5
284–285	Connecting limiting, 65
Client-side honeypots, 231–272	Connection monitors, Honeytrap, 198
active vs. passive, 238–239	Connections, Honeyd packet logs, 132
client-side threats and. See Client-side	Containment policies
threats	minimizing attacks on third-party
detecting rootkits or Trojan horses, 176	systems, 285
high-interaction. See High-interaction	Potemkin, 215, 218
client honeypots	Control socket, Argos, 61–62
low-interaction, finding malicious	Control structure, botnets, 369–372
websites, 241–246	Copy On Write. See COW (copy-on-write)
low-interaction, HoneyC, 246-253	Correlation module, Collapsar, 213
overview of, 231–232	COTS (commercial off-the-shelf)
Pezzonavante, 263–264	computer, 20
research on, 271-272	COW (copy-on-write)
SiteAdvisor, 270–271	Potemkin using, 219
SpyBye, 267–270	UML using, 41–42
studying spyware on Internet, 264–267	virtual high-interaction honeynet with, 52
Client-side threats, 232–241	Crawling engines, 243, 246
client-side honeypots for, 238-241	Create command, 117, 121
exploited Internet Explorer	Crypt layer, Kebes, 287–288
vulnerabilities, 232–233	Crypters, 395
MS04-040, 233-236	CSend, 371
other types of, 236–238	Curl command, 96–97
Clone attacks, 386	Cursor format (.ANI files) vulnerability,
Clone command, 124	232–233
Codbot, 365	Custom mode, VMware, 28
Code analysis, of malicious	cwmonitor.dll, 402-404
software, 394–395	CWSandbox, 391–413
Code injection, DLL, 393, 400-401	analysis of Haxdoor, 319
Code Red, 72	analysis of lightweight IDS based on
Collapsar	nepenthes, 323
architecture, 211–213	API hooking, 396–400
live testing of, 214	architecture, 402–404
Potemkin vs., 214–215	behavior analysis, 395-396
research summary of, 224	code analysis and, 394–395

CWSandbox (continued)	DHCP
code injection, 400–401	Honeyd configuration, 124, 128-129
example analysis report, 406–411	LaBrea configuration, 81
large-scale analysis, 411–413	Dialog boxes, 256
overview of, 392–394	Diffie-Hellman key exchange, Kebes, 288–289
results of, 405–406	Dikes, Jeff, 42
system description, 401-404	Distributed Denial of Service attacks. See
cwsandbox.exe, 402–404	DDoS (Distributed Denial of Service)
Cyberdefense exercise, with Honeyd, 107	attacks
-d runtime flag, Honeyd, 115	DLLs (dynamic link libraries)
	CWSandbox analysis report, 407–408
D.	CWSandbox architecture, 402–403
D	DLL injection, 393, 400–401
Darknets, 206	mIRC-based bots using, 364
Data Analysis, Honeywall, 63–64, 66–68	DMZ, 197, 332
Data Capture	DNX (Dataspy Network X) bot, 365
honeytrap, 197	Domain Name System (Domain Name
Honeywall, 63–64, 66, 68	System), 4, 388
Data ChaOS Connect Back Backdoor,	DoS (Denial of Service) attacks, 64–65
334, 340 Data Control, Honeywall, 63–65, 68	download-*.conf, nepenthes, 180
Data Link Layer, Internet protocol suite, 2	Drone, 360, 376
Data mining, 132	Drop sites (zones), 316
Data mining, 192 Data-oriented protocol, IPv4 as, 3	droprate option, set, 136
Data streams, 4	DRSS (Dynamic Remote Settings Stub), 365
Datagrams, 4	DTK (Deception Toolkit), 73 Dynamic analysis, 392–393, 395–396
Dataspy Network X (DNX) bot, 365	Dynamic IPs, 313–314
Date column, Honeyd, 131	Dynamic link libraries. See DLLs (dynamic
DCOM vulnerability, Windows, 361	link libraries)
dd-attack, 282, 287	Dynamic Remote Settings Stub (DRSS), 365
DDoS (Distributed Denial of Service) attacks	Dynamic taint analysis
caused by botnets, 361, 373, 377-378	Argos and, 53–54, 60
Honeywall mitigating risk of, 62–63	defined, 52–53
IRC wars as, 360	Dynamic templates, Honeyd configuration,
Debian	148–150
installing Honeyd, 108	Dynamic translation, 53-54
installing LaBrea, 75	
installing nepenthes under Linux, 177-178	_
installing UML, 42–43	E
running honeypot in chroot jail, 99	E-mail
Debugging	honeyclients based on, 259, 272
Electric Fence for, 201	phishing for identity theft, 386–387
Honeyd runtime flag for, 115	spyware in the form of bots and, 367
Deception service, DTK, 73	-E (-my-mac-addr) xx:xx:xx:xx:xx, LaBrea
Deception Toolkit (DTK), 73	installation, 79
Delete command, 124–125	eCSIRT.net, 207
Denial of Service (DoS) attacks, 64–65	Elapsed time (ET), Tiny Honeypot, 84
DFN-CERT (Computer Emergency Response	Electric Fence malloc debugger, 201 Encoding, nepenthes, 169
Team), 376	Encoding, hepenthes, 107

Encryption, botnet, 379–380	setting up Honeyd on local network,
EPA (execution path analysis), 302–303	126–128 Wineled for 15-16
ET (elapsed time), Tiny Honeypot, 84	Wireshark for, 15–16
Ethereal. See Wireshark	Frontend, in Collapsar architecture, 211–212
Ethernet option of set command, 120–121,	FTP (File Transfer Protocol), botnet
128–129	setup, 371
Everything honeypot, 88	
exclude, LaBrea configuration, 80	G
Execution path analysis (EPA), 302–303	Gateway, Potemkin, 216–218
-F (-bpf-file) filename, LaBrea installation, 79	GDI (Graphical Device Interface)
-f configfile runtime flag, Honeyd, 114	-
-f (-no-resp-excluded-ports), LaBrea	vulnerability, 233
installation, 78	GenIII honeypots, 63, 166
	Gentoo, 177–178
F	GHH (Google Hack Honeypot), 87–94
	access logging, 92–94
Fedora Core, 42–43	detecting hitlist-based malware, 177
Fetch modules, 167–169, 174	general installation, 87–91
Fidelity	installing transparent link, 91–92
motivating hybrid systems, 209–210	overview of, 87
Potemkin, 215	protecting with Systrace, 103
VMM, 291	GNU adns, nepenthes installation, 178
File Transfer Protocol (FTP), botnet	Google AdSense attacks, 385
setup, 371	Google Hack Honeypot. See GHH (Google
Filesystem, CWSandbox analysis	Hack Honeypot)
report, 408	Graphical Device Interface (GDI)
FileUploadManager honeypot, 88	vulnerability, 233
FIN flag, TCP, 6	GRE (generic routing encapsulation) tunnels
Financial information, identity theft and, 317	Collapsar, 211–213
Fingerprint databases, Honeyd, 115	Honeyd, 113
Fingerprinting tools, 13–18	Potemkin, 216–219
Honeyd deceiving, 111	GT-bots, 364
Nmap, 16–18	Guest kernel, UML, 298
Tedump, 13–15	Guest system (guest virtual machine)
Winnie, 279 Wireshark, 15–16	based on Argos. <i>See</i> Argos based on UML, <i>See</i> UML (User-mode
Firewalls	Linux)
Collapsar frontend acting as, 211–212	based on VMware. See VMware
configuring LaBrea without, 81	defined, 22
enabling on host system, 38	-H (-auto-hard-capture), LaBrea
Flags. See Runtime flags, command-line	
Flow, of malicious network traffic, 207	installation, 79
FRAG_ICMP log, Tiny Honeypot, 86	Н
Fragmentation, IP, 3	handshake, TCP, 6–7
-	
FRAG_UDP log, Tiny Honeypot, 85–86 FreeBSD	Hard drives, searching victim's, 368 hardexclude, LaBrea, 80
how Honeyd works, 106–107	Haxdoor, 316–320
installing Honeyd on, 108–109	Haxplorer honeypot, 88–91
installing LaBrea on, 75–80	Heap spraying technique, 234–235
motaning Labica on, 17-00	ricap spraying iccinique, 277-277

Heritrix, 244, 264–265	Honeyd, 105-161
Hidden page faults, 290, 302	design overview, 109-111
HideWindow executable, in mIRC-based	detecting, 276–279
bots, 364	dynamic templates, 148–150
High-interaction client honeypots, 253-263	experimenting with, 125-129
designing, 254–258	features, 107–108
HoneyClient, 258–262	high-interaction honeypots and, 228-230
HoneyMonkey, 262–263	Honeycomb plug-in, 158–160
overview of, 253–254	Honeydctl application, 156–158
High-interaction honeypots, 19–69	Honeydstats analysis software, 154–156
advantages and disadvantages of, 9–11,	installation and setup, 108–109
20–22	limitations of, 166
Argos. See Argos	overview of, 106–107
defined, 8, 20	packet-level logging, 131–133
Hybrid solutions. <i>See</i> Hybrid honeypot	performance, 160–161
systems	protecting with Systrace, 103
overview of, 19–20	Python Internal Services, 146–148
physical honeypot implying, 11	receiving network data, 112–113
safeguarding, 62–69	routing topology, 150–153
user-mode Linux. See UML (user-mode	runtime flags, 114–115
Linux)	service-level logging, 133–134
VMWare. See VMWare	services, emulating, 139–141
High-interaction honeypots, detecting,	
280–301	services, overview of, 129–131
	subsytems, 142–146
circumventing Honeynet logging, 286–289	Honeyd, configuration, 115–125
Honeywall, 285	add command, 121–123
overview of, 280–281	advanced features for, 136–138
QEMU, 297–298	bind command, 123–124
Sebek, 281–285	create command, 117
UML, 298–301	delete command, 124–125
VMware and other virtual machines,	include command, 125
289–297	overview of, 115–116
HipHop module, for PHP.PoP, 96–97	set command, 117–121
History mode, Potemkin, 218	Honeydctl application, 125, 156–158
Hitlist-based malware, detecting, 176–177	Honeydstats analysis software, 154–156
Holy Father, 399	HoneyMonkey, 176, 262–263
HoneyBOT, 205	Honeynets
HoneyC, 246–253	circumventing logging, 286–289
architecture, 246–248	defined, 21
built-in help for, 249–250	high-interaction, 9
configuration of, 250–253	low-interaction, 11
installation of, 248–249	minimizing risk of attacks on third-party
overview of, 246–253	systems, 285
HoneyClient	virtual high-interaction, with UML, 52
detecting rootkits or Trojan horses with, 176	virtual high-interaction, with VMware, 40
e-mail, 259	Honeypots
overview of, 258–262	collecting malware. See Malware
Honeycomb, 158-160	defined, 7–8

detecting high-interaction. <i>See</i>	Hybrid honeypot systems, 209–230
High-interaction honeypots, detecting	building own, 224-230
detecting low-interaction, 274–280	Collapsar, 211–214
detecting rootkits, 302-304	overview of, 209–210
fingerprinting tools, 13–18	Potemkin, 214–220
high-interaction, 9–10	research summary of, 224
hybrid. See Hybrid honeypot systems	RolePlayer, 220–224
legal aspects of, 12	HyperText Transfer Protocol. See HTTP
low-interaction. See Low-interaction	(HyperText Transfer Protocol)
honeypots	-i (-device) interface, LaBrea installation, 79
overview of, 7–9	-i interface flag, tcpdump, 14
physical, 11	-i interface runtime flag, Honeyd, 114
virtual, 11–12	-I (-my-ip-addr) octet.octet.octet[/size],
Honeytrap, 197–204	LaBrea installation, 79
installation and configuration,	Eudica installation, 77
200–203	I
overview of, 197–200	I/O backdoor, VMware, 293–294
running, 203–204	ICMP, Honeyd packet logs, 132
Honeywall	ICMP, ping requests, 275–276
detecting, 285	Icon format (.ANI files) vulnerability,
installation of, 67–69	232–233
overview of, 9, 63–67	ICS (Internet connection sharing), 29
Hooking	IDE device, detecting UML with, 300
API, 396–399	Identity theft, 316–317, 386–387
System Service, 400	IDS (intrusion detection system). See also NIDS (network intrusion detection
Horde Application Framework	*.
vulnerabilities, 351	systems)
Host kernel, UML, 298	Blast-o-Mat vs. classic IDS, 309
Host system	high-interaction honeypot vs., 20
Argos. See Argos	Honeywall and, 65–66
defined, 22	low-interaction honeypots as, 10–11
taking contaminated hosts offline, 313	monitoring UML-based honeypots, 50
UML. See UML (User-Mode Linux)	monitoring VMware-based honeypots, 38
VMware. See VMware	nepenthes as, 196, 321–325
Hot swap, 187	IDT (Interrupt Descriptor Table), 397, 400
Houseofdabus, 171	Ifconfig, 184
HPOT_DATA log, Tiny Honeypot,	IFRAMES (Inline Floating Frame) tag
85–86	vulnerability, 232, 233–236
hppfs, 300	Ignore mode, Honeytrap, 199
HTML vulnerability	IM (instant messaging), 243, 271
analyzing suspicious sites, 256-257	IMS (Internet Motion Sensor), 206
MS04-040 threat, 232	include command, 125
overview of, 233–236	-init-file filename, LaBrea installation, 79
HTTP (HyperText Transfer Protocol)	Inline Code Overwriting, CWSandbox,
analyzing CWSandbox reports, 412	397–399
botnet setup using, 369-371	Inline Floating Frame (IFRAMES) tag
SDBot and variants using, 363	vulnerability, 232, 233–236
HTTPS web service exploits, 286	Insider attacks, 332

Installation, 67	configuring nepenthes with multiple,
Argos, 54–57	183–185
Google Hack Honeypot, 87–91	defined, 3
HoneyC, 248–249	detecting worms with Billy Goat,
Honeyd, 108–109	205–206
honeytrap, 200–201	determining, 3–4
Honeywall, 67–69	Honeyd handling multiple, 106–107, 111
LaBrea, 75–80	Honeyd receiving network data,
nepenthes, 177–179	112–113
PHP.PoP, 95	Honeywall installation, 67–69
SpyBye, 268–269	LaBrea and, 74–75
Tiny Honeypot, 82–83	IP Aliasing, 184
UML, 42–45	IP forwarding, 29
VMware Player, 29–31	IP routing, 7
VMware Server, 31–33	IPC (interprocess communication),
Instant messaging (IM), 243, 271	CWSandbox, 402
Integrity checks, 255–256	ipconfig, 48
internal keyword, Honeyd, 122	ipignore, LaBrea configuration, 80
Internal Reflect mode, Potemkin, 218	ip.queue interface, 198
Internet	iproute2 utilities suite, 183–184
connecting honeypot running Argos	IPS (Intrusion Prevention System),
to, 60	65–66
connecting honeypot running UML	Iptables rule, 198
to, 51–52	IPv4, 3
connecting honeypot running VMware to,	IRC-based honeyclients, 271
39–40	IRC bots, 240
studying spyware on, 264–267	IRC (Internet Relay Chat) server
testing high-interaction client	Agobot and its variants using, 362-363
honeypots, 257	analyzing in CWSandbox reports, 412
Internet Archive, 244	botnet case studies, 377–380
Internet connection sharing (ICS), 29	botnet setup using, 369
Internet Explorer, 232–233, 270–271	bots using, 360-361, 365-366, 385-386
Internet Motion Sensor (IMS), 206	mIRC-based bots using, 364
Internet protocol suite. See TCP/IP	observing botnets with, 375-376
(Transmission Control Protocol/ Internet	SDBot and variants using, 363
Protocol)	IRC wars, 360
Internet protocols. See Network protocols	ircoffer, 214
Internet Sink (iSink), 226–228	ISC (Internet Storm Center), 206
Internet Storm Center (ISC), 206	ISink (Internet Sink), 226-228
Interprocess communication (IPC),	ISO images
CWSandbox, 402	Honeywall installation, 68
Interrupt Descriptor Table (IDT), 400	installing OS on virtual honeypot, 33-34,
Intrusion detection system (IDS). See also	36–37
NIDS (network intrusion detection	
systems)	K
Intrusion Prevention System (IPS), 65-66	Kaiten, 366
IP addresses	Kebes, 287–288
binding templates to, 123–128	Kernel memory, detecting Sebek, 282–284

Kernel Rebuild Guide, 45	Locking infected systems, 313–314
Keylogger	log-*.conf, nepenthes, 180
bots using, 366-367, 386	Logging
client-side attacks installing, 240	circumventing on Honeynet, 286-289
Spybot, 368-369	detecting Sebek, 281–282
KQEMU, 54–57	Logging module
-l (-log-to-syslog), LaBrea installation, 78	Collapsar, 213
-l logfile runtime flag, Honeyd, 115	defined, 167–168
	Google Hack Honeypot, 92–93
L	Honeyd, 115, 131–133
LaBrea, 74–81	Tiny Honeypot, 83–86
configuration, 79–80	UML-based honeypots, 50–51
detecting, 277	Logical discrepancies, detecting virtual
installation, 75–79	machines, 295-296
observations, 81	Low-interaction client honeypots
overview of, 74–75	finding malicious websites, 241-246
Legal issues, of honeypots, 12	HoneyC, 246–253
libcurl, 178	overview of, 241
libdnet, 75-76, 108	Low-interaction honeypots, 71-103
libevent, 108	advantages and disadvantages of, 10-11,
libmagic, 178	72–73
libpcap	Deception Toolkit, 73
Agobot and its variants using, 363	defined, 8, 72
honeytrap connection monitor based on,	detecting, 274–280
198	Google Hack Honeypot. See GHH
installing for Honeyd, 75–76	(Google Hack Honeypot)
installing for LaBrea, 75–76	Honeyd. See Honeyd
Libraries, vulnerabilities in, 237. See also	Hybrid solutions. See Hybrid honeypot
DLLs (dynamic link libraries)	systems
Link analysis, 334	LaBrea, 74–81
Linux	nepenthes. See Nepenthes
chroot utility and, 99–100	PHP.HoP, 94–97
Honeyd and, 106-109, 126-128	securing with chroot jail, 98-100
Honeytrap connection monitor in, 198	securing with Systrace, 100-103
installing LaBrea, 75–80	Tiny Honeypot, 81–86
installing nepenthes, 177-179	LSASS vulnerability, Windows, 361
NMap for, 16–18	LSASSDialogue.cpp, 172
setting up virtual honeypots with, 12, 29–33	
Systrace for, 101–102	M
UML only running on, 41	MAC addresses
VMware Player for, 30	configuring Honeyd with ethernet option,
VMware with, 28-29, 34-37	120–121, 128–129
Wireshark for, 15-16	defined, 3
Linux Kernel Archives, 43	detecting virtual machines via, 292-293
LKM (loadable kernel module), 302	Mac OS X
Loadable kernel module (LKM), 302	installing Honeyd, 108–109
Local nepenthes sensor, 185-186, 196	using Parallels as VMM for, 292-293

Mac OS X (continued)	Microsoft Distributed Transaction
virtualization options for, 23	Coordinator (MSDTC), 188
Wireshark for, 15–16	mIRC-based bots, 364
Malicious software. See Malware	Mirror mode, honeytrap, 199, 202-203
Malicious websites	Mitigation, nepenthes, 311–312
analyzing downloaded content, 244-246	Mocbot, 381–384
attackers setting up, 239	module-*.conf, nepenthes, 180
finding suspicious sites, 241–244	Monitoring honeypots
high-interaction client honeypots searching	UML-based, 50–51
for, 254–255	VMware-based, 37–39
HoneyC searching for, 246-253	Morphine, 362
Malware, 163–207	Mozilla Firefox, 236, 270–271
analyzing with CWSandbox. See	MSDTC (Microsoft Distributed Transaction
CWSandbox	Coordinator), 188
client-side attacks installing, 239-240	Multipot, 204–205
collecting with Billy Goat, 205-206	Mutex objects, 408–409
collecting with HoneyBOT, 205	MySQL database, 93–94
collecting with Honeytrap. See Honeytrap	Mytob, 364
collecting with Multipot, 204-205	-n flag, tcpdump, 14–15
collecting with nepenthes. See Nepenthes	-n (-network) octet.octet.octet [/size],
introduction to, 164–165	LaBrea installation, 79
learning about malicious traffic,	
206–207	N
overview of, 163–164	NAT (network address translation)
spreading sequentially or randomly, 185	creating virtual honeypots, 33
spreading with botnets, 385	deploying honeypots, 12
as threat to Internet, 309	high-interaction honeypots and, 224-228
top ten types of, 195	virtual networks with UML and, 48
MD5 hash, code analysis of, 395	virtual networks with VMware and, 27–29
memory, detecting Sebek from, 282-284	National Security Agency (NSA), 107
Memory dumps, Argos, 60	Native API, 396–397
Meta-honeypots, 199	Needleman-Wunsch algorithm, RolePlayer,
MHTML processing vulnerability, 232	223
Microsoft. See also Windows	NefFlow/cflow, 206–207
MS03-039 exploit, 60-61	Nepenthes, 165-197. See also Blast-o-Mat
MS04-007 exploit, 237	analyzing CWSandbox reports with,
MS04-011 exploit, 171	411–413
MS04-013 exploit, 232	architecture of, 167–170
MS04-040 exploit, 232-236	assigning multiple IP addresses with,
MS05-002 exploit, 232-233	183–185
MS05-039 exploit, 187-188, 364	benefits of, 321
MS05-051 exploit, 188	capturing new exploits with, 186-187
MS06-001 exploit, 232-233	command line flags, 181–183
MS06-040 exploit, 381-384	configuring, 179–181
MS06-057 exploit, 232-233	customizing, 181
popular programs targeted, 236	detecting, 279–280
vulnerabilities of Internet Explorer,	example of, 170–176
232–233	flexible deployment of, 185–186

installing, 177–179	reading files with Kebes and, 288
lessons learned, 196–197	testing Honeyd's deception of, 127-128
lightweight IDS based on, 321–325	-no-arp-sweep, LaBrea installation, 79
limitations of, 176–177	NSA (National Security Agency), 107
overview of, 165–167	-O flag, NMap, 17
results of, 188–196	-o (-log-to-stdout), LaBrea installation, 78
Surfnet IDS use of, 326	-O pOf-file runtime flag, Honeyd, 115
tracking botnets with, 374	
vulnerability modules of, 187–188	O
nepenthes.conf, 179	Oberheide, John, 278–279
NetBSD	Observed behavior, CWS and box analysis,
Honeyd and, 106-109, 126-128	406–407
Systrace for, 101–102	Office applications, vulnerabilities in, 238
Wireshark for, 15-16	OLE automation, 255
Netcat, 347	-oN/-oX/-oG file, NMap, 18
Netfilter logs, Tiny Honeypot, 85–86	Online polls/games, and botnets, 386
Netflow/cflow, 389	Online resources
network address translation. See NAT	AdAware, 265
(network address translation)	Argos honeypots, 54
Network intrusion detection systems. See	bot attacker tools, 362
NIDS (network intrusion detection	botnets, 390
systems)	Collapsar research study, 214
Network Layer, Internet protocol suite, 2	crawling engines, 243–244
Network protocols	CWSandbox, 394, 413
Honeyd packet logs, 131–132	Deception Toolkit (DTK), 73
Honeyd receiving network data, 112–113	defining honeypots, 8
TCP/IP, 1–6	e-mail honeyclient, 259
Network socket, Argos, 61–62	Heritrix, 264
Network telescopes, 206	HoneyBOT, 205
Networks, 126–128	HoneyC, 246, 261–262
configuring Argos, 57–61	HoneyClient, 258–259
of honeypots. See Honeynets	Honeyd, 108–109
setting up Honeyd on local, 126–128	HoneyMonkey, 262–263
virtual. See Virtual networks	Honeynet groups, 12
vulnerabilities in university, 309	Honeytrap, 197
New Zealand Honeynet Project, 195	Honeywall, 67, 69
Newsgroups, 243	iproute2 utilities suite, 183
NIDS (network intrusion detection systems).	LaBrea installation, 76
See also Blast-o-Mat	legal aspects of running honeypots, 12
decreasing usefulness of, 7	Linux Kernel Archives, 43
honeypots vs., 8–9	memory dumps, 60
Surfnet IDS, 325–326	MS04-040 threat, 233-234
Nmap	Multipot, 204
assigning personality to templates from,	nepenthes, 166, 186
117–120	nepenthes installation requirements,
circumventing honeynet logging using, 287	178–179
detecting nepenthes, 279–280	NMap, 17
overview of, 16–18	Outlook Redemption, 259

Online resources (continued) QEMU, 34–35	Parallels Desktop, 23
root filesystem download, 46	as VMM for Mac OS X, 292–293
Sebek, 39	Workstation, 23
SiteAdvisor, 270	Parameters, set command, 118
tcpdump, 13	Passive client-side honeypots, 238–239
typosquatting, 243	Passlist.txt honeypot, 88
UML, 42	Passwd.list honeypot, 88
VMM, 292	Password dumpers, 347
VMware Player download, 30	Passwords
VMware Server download, 32	botnet setup using, 371–372
VMware Technology Network, 31	bots using weak, 361–362
VMware versions, 25–26	configuring Honeywall, 68
Windump, 13	pause command, Argos, 62
Wireshark, 15	pcap, honeytrap, 201–202
open, Honeyd configuration, 118	PCRE (Perl Compatible Regular Expressions)
open system call, 101	library, 178, 363
OpenBSD	Peer-to-Peer (P2P) communications. See P2P
Honeyd installation, 109	(Peer-to-Peer) communications
setting up Honeyd on local network,	Performance
126–128	Collapsar, 213
Systrace for, 101–102	Honeyd, 160–161
Operating systems	hybrid systems, 209–210
configuring Honeyd to simulate, 107	VMM, 291
installing on virtual honeypot, 33–34,	VMware guest system, 23
36–37	Perl Compatible Regular Expressions (PCRE)
Oracle databases, vulnerabilities in, 236	library, 178, 363
Outlook/Outlook Express, 236–237,	Perl scripts, 340, 341
259–260	Persistent capture, LaBrea, 75
Outlook Redemption, 259–260	Personality, assigning, 117–120
-p fingerprints runtime flag, Honeyd, 115	Pezzonavante, 263–264
-p (-max-rate) datarate, LaBrea installation,	Phishing, 351, 354, 386–387
76–77	phpAdsNew vulnerability, 333
-P (-persist-mode-only), LaBrea	PHPBB_Installer honeypot, 88
installation, 77	PHPFM honeypot, 88
-p port-ranges flag, NMap, 17	PHP.HoP
	HipHop module, 96–97
	installation, 95
P	overview of, 94
P2P (Peer-to-Peer) communications	PhpMyAdmin module, 97
Agobot and its variants using, 362	PhpMyAdmin module, 97
botnet setup using, 371	PHP_Ping honeypot, 88
bots propagating using, 361-362, 365	PHP_Shell honeypot, 88
honeyclients based on, 272	Phrack magazine, fake release of
Packet-level logs, Honeyd, 131–133	articles on honeypot detection, 280
Packet sniffers, 386	detecting and disabling Sebek,
Packet switched networks, 3	281–283
Packets, TCP, 4–5	detecting Honeyd, 277

Physical honeypots, 8, 11. See also	Queuer, HoneyC, 246–248
High-interaction honeypots	-r (-arp-timeout) seconds, LaBrea
Physical Layer, Internet protocol suite, 2	installation, 77
PhySysInfo honeypot, 89	-r filename flag, tcpdump, 15
PID (process ID), Tiny Honeypot, 84	
ping flood, 275	R
Plug-ins	RADIUS (Remote Authentication Dial In
HoneyC, 248	User Service), 314
honeytrap, 200, 203-204	RAM
pmn, LaBrea configuration, 80	high-interaction virtual honeypot
Policies	requirements, 29
configuring Systrace, 101–103	HoneyBOT requirements, 205
minimizing attacks on third-party systems	Honeywall installation requirements, 67-69
with containment, 285	MWare requirements, 24
Potemkin containment, 215, 218	SiteAdvisor requirements, 270
Revisit, 245–246	virtual machine requirements, 24
port-helper utility, UML, 49	RATs (Remote Access Trojans), 204
Port ranges, LaBrea configuration, 80	RBot, 323, 363–364
portignore, LaBrea configuration, 80	read() method, Sebek, 281-284, 286-287
Portwatch modules, nepenthes, 186–187	RealPlayer vulnerabilities, 236
Potemkin, 166	Reconnaissance, high-interaction honeypots,
architecture, 216–220	20
live testing of, 219–220	Red Hat 8.0 case study, 332-343
overview of, 214–216	evaluation of attack, 343
research summary of, 224	overview of, 332–333
/proc, 300	summary of attack, 334-335
Process ID (PID), Tiny Honeypot, 84	timeline of attack, 335-338
Protected Storage (PStore), 317–318	tools involved in attack, 338-343
Protocol Proxy mode, Potemkin, 218	RedPill VMM detection code, 296-297
Proxy ARP, 106, 113, 120	Registry access, CWSandbox, 409-410,
proxy keyword, Honeyd, 122	412–413
Proxy mode, Honeytrap, 199	Remote Access Trojans (RATs), 204
PSH flag, TCP, 6	Remote Authentication Dial In User Service
PStore (Protected Storage), 317-318	(RADIUS), 314
Ptrace vulnerability, Linux, 340, 343	reset command, Argos, 62
Python, 288–289	reset command, Honeyd, 118
Python Internal Services, 146-148	Resource discrepancies, detection with, 295
	resume command, Argos, 62
Q	Revisit policy, 245–246
Q8Bot, 366	Risk, of honeypots
qemu, 54–57	high-interaction, 21
QEMU	high-interaction vs.low-interaction, 11
Argos based on, 53–54	legal aspects of, 12
creating virtual honeypot with, 34-37	RolePlayer
detecting, 297–298	applications of, 223–224
installing for Argos, 54–57	overview of, 220–223
QEMU Accelerator, 34–37	research studies, 224
Quarantines, 313–315	Root filesystem, UML, 41–42, 46–49

root user, 100 Rootkits CWSandbox functionality for, 404 detecting, 302–304	Scripts configuring Honeyd with services, 129–131 Data ChaOS Connect Back Backdoor, 340 UDP flooder, 341
Haxdoor capabilities, 316	web applications and, 333
nepenthes incapable of detecting, 176	SDBot, 363-364, 367-368
SHv5 rootkit, 338-340	SDL (Simple DirectMedia Layer)
Routers	development libraries, 55
as high-interaction honeypots, 20	Search engines, finding malicious websites,
how Honeyd works, 106–107	242
Potemkin architecture, 216–218	Search Worms, 327–332
Routing topologies, Honeyd, 108,	applied to Santy worm, 328–332
150–153	overview of, 327
RPC DCOM exploit, 60–61	sequence of operations executed by,
RPM-based VMPlayer, 30	327–328
RST flag, TCP, 6	Sebek
Ruby, 248–249	capturing information with, 9
Runtime flags, command-line	circumventing logging by, 286–287
Honeyd, 114–115	detecting, 281–284
honeytrap, 203–204	disabling, 284–285
LaBrea installation, 76–79	monitoring VMware-based honeypots, 39
nepenthes, 181–183	overview of, 66–67
NMap, 17–18	Security
TCP, 6	connecting virtual honeypots to Internet,
tcpdump, 14–15	39–40, 51–52
UML runtime, 46–49	high-interaction honeypots, 62–69
-S flag, tcpdump, 15	honeytrap, 201
-s servicelog runtime flag, Honeyd, 115	Honeywall, 63–69
-s snaplen flag, tcpdump, 15	LaBrea installation, 76
-s (-switch-safe), LaBrea installation, 78	low-interaction honeypots, 98–103
S	nepenthes installation, 178
	Seed, Heretrix, 265
Safety, VMM, 291	Segments, TCP, 4
Sandbox, Norman, 405–406	Semiglobal alignment algorithm, RolePlayer, 223
Sandboxing. See CWSandbox SANS Top-20 Internet Security Attack Targets	Sensors, nepenthes, 185–186, 196
for 2006, 237	Sequence numbers, TCP, 4–5
Santy worm, 327–332	Service Control Manager (SCM)
Scalability	vulnerabilities, Windows, 319–320
Collapsar, 213	Service emulation, honeytrap, 198–199
motivating hybrid systems, 209–210	Services, Honeyd
nepenthes, 166, 170, 190–193	configuring, 107, 129–131
Potemkin, 215	emulating, 139–141
virtual honeypots, 11–12	log files, 133–134
VMware, 23–24	runtime flag, 115
SCM (Service Control Manager)	Session ID (SID), Tiny Honeypot, 84–85
vulnerabilities, Windows, 319–320	Session logs, Tiny Honeypot, 85
Scoopy Doo, 296–297	set command, Honeyd
17	

droprate option, 136	SpyBye, 268–270
ethernet option, 120–121	Spyware
overview of, 117–120	as bots, 366–369
uid option, 137	client-side attacks installing, 240
uptime option, 120	studying on Internet, 264–267
setSlice ( ) vulnerability, WebViewFolderIcon	SquirrelMail honeypot, 89
Active X control, 233	SSDT (System Service Dispatch Table),
SGDT instructions, 295–296	397, 400
SHA-512 hash, 395	Static analysis, malicious software, 392–393
Shadow honeypots, 187	Static IPs, 313
Shell emulation, nepenthes, 169–170, 176	Statistics, nepenthes, 188–189, 193–196
Shell scripts, configuring Honeyd, 129–131	stdin, Honeyd, 129–130
Shellcode-executer extension, Python,	stdout, Honeyd, 129–130
288–289	Storm Worm bot, 365
shellcode-generic.conf, nepenthes, 180	strace tool, 99–100
Shellcode parsing modules	su command, Honeywall, 68
defined, 167–168	Submission modules, 167–169, 174
example of, 172–174	submit-*.conf, nepenthes, 180
overview of, 169	Subsytems, Honeyd, 108, 142–146
shutdown command, Argos, 62	sudo command, Honeyd, 126
SHv5 rootkit, 338–340	SURFnet IDS, 325–326
SID (session ID), Tiny Honeypot, 84–85	SUSE 9.1 case study, 351–357
SIDT instructions, 295–296	evaluation of attack, 356–357
Simple DirectMedia Layer (SDL)	overview of, 351
development libraries, 55	
	summary of attack, 351–352 timeline of attack, 352–354
SiteAdvisor, 270–271	
skas, 301	tools involved in attack, 354–356
SLDT instructions, 295–296	-sV flag, NMap, 17
SMTP, analyzing CWS and box, 412	svchost processes, 176
Snapshot mechanism, of QEMU, 57	SVM (Pacifica), 296
Snort system	Switches, 20
HoneyC searching for malicious web	Symantec, 405–406
servers based on, 246–248	SYN flag, TCP, 6
monitoring VMware-based honeypots, 38	System call interposition, 101
snort_inline	System Service Dispatch Table (SSDT),
IPS based on, 65	397, 400
minimizing risk of attacks on third-party	System Service hooking, 400
systems, 285	Systrace, 100–103
SOCKS proxy, 240	ar.
Software	T
malicious. See Malware	T (-dry-run), LaBrea installation, 78
monitoring VMware-based honeypots,	-t (-throttle-size) database, LaBrea
37–39	installation, 76
virtualization, 22	-T[0-5] flag, NMap, 17
SP2, Windows, 327	tap0 virtual device, 48–49
Spamming, 385	tar.gz-ball, 30
Spear phishing, 367	Tarpits, 74
Spybot, 363–364, 368–369	Tarpitting module, Collapsar, 213

Tcdump, 13–15	Traffic redirectors, Collapsar, 211–212
TCP/IP (Transmission Control Protocol/	Translation look-aside buffer
Internet Protocol), 1–2	(TLB), 295
TCP SYN flooding attacks, 372–373	Transmission Control Protocol. See TCP
TCP SYN packets, 279	(Transmission Control Protocol)
TCP (Transmission Control Protocol)	Transmission Control Protocol/Internet
detecting low-interaction honeypots,	Protocol (TCP/IP), 1–2
276–280	Transport Layer
Honeyd packet logs, 132	Internet protocol suite, 2
Honeytrap and, 198–200	TCP, 4–6
LaBrea utilizing, 74–75	UDP, 4
understanding, 4–7	Trivial File Transfer Protocol (TFTP), botnets
tcpdump, 50, 66	using, 371
Templates, Honeyd	Trojan horses, 176, 316–320
add command, 121–123	TT (Tracing Thread) mode, UML, 298
advanced configuration, 136–138	tty logging, 50–51
bind command, 123–124	TUN/TAP device, 48, 300
create command, 117	tunctl utility, UML, 49
defined, 117	Typosquatting (URL hijacking), 242–243
delete command, 124–125	Typosquatting (ORL injacking), 242–24)
dynamic, 148–150	U
set command, 117–120	
TFTP (Trivial File Transfer Protocol),	UDP (User Datagram Protocol)
	flooding attacks, 341, 372–373
botnets using, 371	Honeyd packet logging with, 132
thp (Tiny Honeypot), 81–86	overview of, 4–5
capture logs, 83–85	uid option, set command, 137
installation, 82–83	UML (User-mode Linux), 41–52
netfilter logs, 85–86	building virtual high-interaction
observations, 86	honeynet, 52
overview of, 81–82	connecting virtual honeypot to
session logs, 85	Internet, 51–52
Throttling, LaBrea, 75	detecting, 298–301
Timestamps, 120, 131	installation and setup, 42–45
Timing-based detection, 295	monitoring honeypots, 50–51
detecting low-interaction honeypots,	overview of, 41–42
276–280	runtime flags and configuration,
detecting virtual machines, 295	46–49
through hidden page faults, 302	setting up virtual honeypots, 12, 21
Tiny Honeypot. See thp (Tiny Honeypot)	uml_net utility, UML, 49
Titan Rain attacks, 238	uml_switch utility, UML, 49
TLB (translation look-aside buffer), 295	UNICODE, analysis of, 395
Tools, fingerprinting, 13–18	Updates
Nmap, 16–18	bots using, 361, 378
tcdump, 13–15	Windows vulnerabilities, 361
Wireshark, 15–16	uptime option, set command, 120
Toxbot, 365	UPX, 362
Tracing Thread (TT) mode, UML, 298	UrBot, 363–364
Tracking, botnets, 373–376	URG flag, TCP, 6

URLs, malicious analyzing suspicious sites, 244–246 analyzing with SpyBye, 268–270 high-interaction client honeypots finding/analyzing, 254–258 looking for, 241–244 urls.txt file, 260 UrXBot, 363–364	Visitor, HoneyC, 246–247 VMM (virtual machine monitor) detecting presence of, 295–296 overview of, 290–292 Potemkin using, 218–219 vmnet, 28 VMTN (VMware Technology Network), 31
User-Agent field, HTTP header, 243	VMware, 22–40
User Datagram Protocol. See UDP (User	adding monitoring software, 37–39
Datagram Protocol)	building virtual high-interaction
User-mode Linux. See UML (User-mode	honeynet, 40
Linux)	combining with Honeyd, 111
Usernames	connecting virtual honeypot to Internet,
botnet setup, 372	39–40
bots using weak, 361–362	creating virtual honeypot, 33–37
configuring Honeywall, 68	detecting, 289–296
USR1 signal, 132–133	overview of, 22–25
-v (-verbose), LaBrea installation, 78	preventing detection of, 296–297
. ( , ,	setting up virtual high-interaction
	honeypot, 29–33
V	setting up virtual honeypots, 12, 21
Vanderpool (VT), 296	versions of, 25–26
Variable expansion, Honeyd, 122–123	virtual network with, 26-29
Versions, VMware, 25–26	VMware ESX Server, 26
Virtual filesystem, nepenthes, 170	VMware Fusion, 23
Virtual honeypots	VMware GSX Server, 25–26
advantages and disadvantages, 11–12	VMware Player
connecting to Internet, 39–40	creating virtual honeypot for VMware,
creating, 33–37	34–37
defined, 8	overview of, 25–26
Virtual machine monitor. See VMM (virtual	setting up virtual honeypot, 29-33
machine monitor)	VMware Technology Network
Virtual machines. See also .vmx files	(VMTN), 31
analyzing spyware on Internet with, 265	VMware Workstation, 25, 33-34
Collapsar architecture, 212	VMwareServer
detecting, 289–297	creating virtual honeypot for VMware,
Potemkin architecture, 216-217	33–34
virtualization vs. emulation	installation and setup for, 31-33
of, 297–298	overview of, 25–26
Virtual networks	.vmx files
setting up with Argos, 59–61 setting up with UML, 47–49	creating virtual honeypot for VMware with OEMU, 35
setting up with VMware, 26–29	preventing detection of VMware, 297
Virtual PC, 23	virtual machine format, 31
Virtual FC, 25 Virtual system, 22	VPN tunnel, deploying nepenthe, 186
Virtual system, 22 Virtualization software. See VMWare	VT (Vanderpool), 296
Virusscan, CWSandbox, 407	vuln-*.conf, nepenthes, 180
virusscari, G w sandbox, 707	vanicom, nepenales, 100

Vulnerabilities. See also botnets; client-side	monitoring UML-based honeypots, 50
threats; Microsoft; Windows	overview of, 15–16
Horde Application Framework, 351	.WMF (Windows Meta Files)
ptrace in Linux, 340, 343	vulnerability, 233
search engines for finding, 327	the state of the s
	Worms. See also Search Worms
in XAMPP, 344	Blaster worm, 220–221
Vulnerability modules	Bofra worm, 235–236
defined, 167-168	containing, 327
detecting nepenthes remotely, 177	detecting with Billy Goat, 205-206
example of, 172–173	Storm Worm, 365
implementing, 187–188	Windows SP2 features for preventing, 327
overview of, 168	Zotob worm, 187–188, 364
results of, 188–189	-x (-disable-capture), LaBrea installation, 78
,	-X (-exclude-resolvable-ips), LaBrea
W	installation, 78
-w filename flag, tcpdump, 15	-X flag, tcpdump, 15
	-x (-hard-capture), LaBrea
W32.Randex.D worm, 223	installation, 78–79
Web spidering attacks, 372	
Webattacker, 250–252	-x xprob runtime flag, Honeyd, 115
Websites, malicious, 241–246	
WebUtil2.7 honeypot, 89	X
Wever, Berend-Jan, 234	x2.conf, nepenthes, 180
Windows	XAMPP, vulnerabilities in, 344
API hooking, 396–400	
how Honeyd works in NT 4, 106–107	XOR encoder, 169, 173–174
installing QEMU to use with Argos, 57	Xot bot, 365
SP2 features for preventing worms, 327	XT Bot, 365
VMware for, 22, 28–37	
vulnerabilities to botnets, 361, 378, 380	Y
vulnerabilities to Haxdoor, 319–320	<del>-</del>
Wireshark for, 15–16	Yahoo search queuer, HoneyC, 246–247
Windows 2000 case study, 343–351	
	Z
evaluation of attack, 350–351	_
overview of, 343–344	Zero-day (Oday) attacks
summary of attack, 344	defined, 253
timeline of attack, 345–347	detecting with Argos. See Argos
tools involved in attack, 347–350	extending nepenthes to handle, 186–187
Windows Explorer vulnerability, 233, 257	handling, 189
Windows Meta Files (WMF) vulnerability, 233	high-interaction honeypots detecting,
Windump, 13	253–254
Winnie fingerprinting tool, 279	Internet Explorer vulnerabilities to, 233
Winsock, 410	low-interaction honeypots not for, 72
Wireshark	against Office applications, 238
Honeywall enabling Data Capture	Zombie, 360
through, 66	Zotob worm, 187–188, 364
3 · 7 ·	, ,